ORIGINS OF PREHISTORIC POTTERY IN THE CAROLINA SANDHILLS: A CHEMICAL AND PETROGRAPHIC STUDY

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OVERVIEW

The goal of this study is to explore patterns of residential mobility and land use among Native Americans living in the North Carolina Sandhills during the Woodland era (ca. 1500 B.C.– A.D. 1600). The geographic scale of the study is designed to be relevant to the cultural landscapes of prehistoric hunter-gatherers whose subsistence economies focused on resources in the Sandhills and adjacent river valleys. The unit of analysis is pottery recovered from archaeological sites on Fort Bragg and in adjacent river valleys. Determining the source locations for the manufacture of prehistoric of pottery and, once made, where pots were conveyed, provides a means of understanding prehistoric group mobility and social interaction. Moreover, this information is critical in determining the significance of archaeological sites found on and around Fort Bragg, which comprises about 250 mi^2 within the North Carolina Sandhills.

METHODS

In addition to using standard descriptive techniques for classifying pottery samples, we have characterized the constituents of each sample with instrumental neutron activation analysis (INAA) and optical petrography to explore correlations and, ultimately, to attempt to determine the geologic or geographic source locations where ceramic vessels were made.

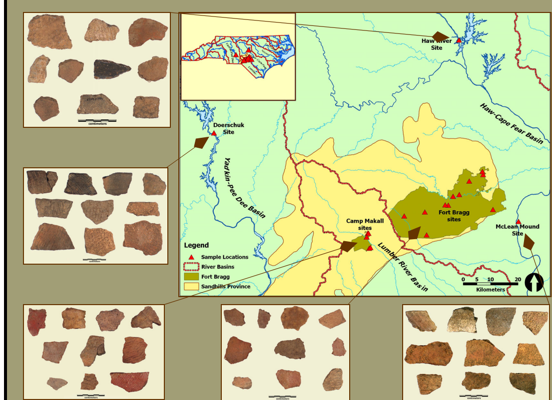


Figure 1. Pottery sample locations from archaeological sites in three river basins in and around the North Carolina Sandhills.

SAMPLES

Ceramic samples were drawn from 19 archaeological sites situated in three different river basins: (1) the Haw-Cape Fear, (2) the Lumber, and (3) the Yadkin-Pee Dee. Ten potsherds were drawn from the Haw River site on the lower Haw River, now impounded as B. Everett Jordan Lake, representing an eastern Piedmont source area. Ten potsherds were drawn from the Breece site in the middle Cape Fear basin on the upper Coastal Plain. Ten potsherds were drawn from the Doerschuk site, representing an eastern Piedmont source area on the lower Yadkin River. Ten potsherds were drawn from sites in the Lower Little River basin on Fort Bragg representing the upper Coastal Plain Sandhills area in the Cape Fear drainage. Ten potsherds were also drawn from six sites in the Drowning Creek basin on Camp Mackall representing the Coastal Plain Sandhills area in the Lumber River drainage.

Lower Little River and Drowning Creek are situated entirely within the Coastal Plain Sandhills, with none of their tributaries originating in the Piedmont. Although the Breece site is situated in the Coastal Plain, it is on the Cape Fear River, which flows from Piedmont sources. At the outset then, it was expected that the pottery from the Breece site might be composed in some part of redeposited alluvial sediments derived from the Piedmont. In contrast, pottery from Fort Bragg and Camp Mackall are expected to derive entirely marine sedimentary clays deposited on the upper Coastal Plain in the Cretaceous era.

RESULTS OF INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS (INAA)

The INAA produced elemental concentration values for 32 or 33 elements in most of the samples. These data were explored to assess the similarity and dissimilarity among the regions sampled by standard procedures for the analysis of data of this kind (Bieber et al. 1976; Bishop and Neff 1989; Harbottle 1976: 42-60; 1976; Neff 2002; Sayre 1975; Speakman and Glasscock 2002). Principal components analysis (PCA) of the 50-specimen data set indicated that there were five recognizable compositional groups in the data. Ten specimens remained unassigned to a compositional group. Probabilities of membership in the five compositional groups calculated on the first three principal components subsume a little over 77 percent of total variation. The five-group structure appears on the first two principal components derived from the PCA of the data set variance-covariance matrix. Groups separate primarily along Principal Component 2, which expresses a large share of the variation in calcium concentrations in the data (Figure 2). Groups 3 and 4 are low in calcium, while Groups 1, 2, and 5 are high in calcium.

Seventy-five percent of the samples from the Doerschuk (Pee Dee River, Piedmont) and Haw River sites (Haw River, Piedmont) have membership in Groups 1, 2, or 5 (Table 1, Figure 3). The five remaining samples from these sites are unassigned but also have high calcium, sodium, and manganese concentrations. Initially, the higher calcium and sodium concentrations in Groups 1, 2, and 5 seemed to indicate the influence on these group profiles of calcareous materials derived from Pleistocene and more recent alluvial clays along the rivers and creeks north and west of Fort Bragg, suggesting a local origin for the Pee Dee and Haw river samples. This interpretation assumes that the clays in this region are calcareous and that they are alluvial, but as subsequent mineralogical analyses show, the source of the calcium is not fossil shell or carbonate rock, but calcium- and potassium-rich igneous rock fragments purposefully added to the pottery as a tempering agent. Nevertheless, it is clear that the chemical signatures of ceramic samples from the Piedmont are distinctive when compared to most potsherds recovered on Sandhills sites and at the Breece site.

The predominance of Cape Fear basin samples in Group 3, suggests that pottery in this group originates from the Cape Fear vicinity. Consequently, it is possible that the Group 3 pottery found in the Lumber and Lower Little River drainages was made from clays local to the Cape Fear area and subsequently brought into the Sandhills. It is equally plausible that some clay resources in the Fort Bragg region (Lower Little, and Lumber drainages) share ranges of variation similar to Cape Fear clays. The fact that Group 4 clays are found only at sites in the Sandhills, suggests that whereas potters from the Breece site utilized a specific clay type/source, potters in the Lower Little and Lumber drainages utilized clays from multiple locations.

Table 1. Contingency Table of Chemical Groups and River Basin/Site Locations.

Chemical Groups	Pee Dee/ Doerschuk	Haw/ Haw River	Cape Fear/ Breece	Lower Little/ Fort Bragg	Lumber/ Camp Mackall	Total
	River Basin/Site(s)					
1	2	2		1		5
2	1	4		2	1	8
3			9	3	3	15
4				4	2	6
5	4	2				6
unx	3	2	1	2	2	10
Total	10	10	10	12	8	50

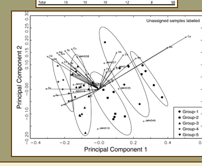


Figure 2. PCA biplot of principal components 1 and 2 of the correlation matrix for 30 elements determined in the Fort Bragg Pottery sample. Ellipses represent 90% confidence level for membership in the five chemical groups.

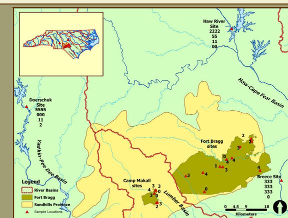


Figure 3. Sample locations and chemical groups (labeled for each sample at each site provenience). Samples unassigned to one of the four chemical groups are shown as 0. Note especially the differences between Piedmont sites (Doerschuk and Haw River sites) and Coastal Plain sites.

RESULTS OF MINERALOGICAL PETROGRAPHIC ANALYSIS

Thin sections were made from each of the 50 pottery samples and petrographic analysis was conducted in a manner consistent with practices standard in optical mineralogy (Smith 2003). On the basis of mineralogical data, the samples were sorted into three categories: *Group I*, those including a mineral suite composed mostly of pyroxene and plagioclase derived from mafic igneous rock; *Group II*, those including quartz, feldspar, biotite, muscovite, amphibole, and opaque minerals and felsic igneous rock fragments, variation being controlled by the amount of mafic and opaque minerals; and *Group III*, a group composed of monocrystalline quartz and polygranular quartz rock fragments with variable amounts of muscovite mica, grog and argillaceouos clay fragments (ACF).

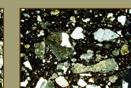
Group I is represented by one potsherd from the Doerschuk site, two potsherds from the Haw River site, and one potsherd from a site on the Lower Little River on Fort Bragg. The ceramic matrix of these potsherds consists of about 30 percent pyroxene and plagioclase rock fragments probably from the Jurassic-age diabase dikes that crosscut eastern and central Piedmont North Carolina. Some fragments are nearly pristine, suggesting a source close to an exposure of the diabase. Others exhibit a more altered condition, suggesting more time for weathering process to act (Smith 2003:6). Modern comparative samples from an exposure of diabase near Albemarle in Stanly County appear identical to the fragments found in some of the Group-I samples.

Group II is subdivided into two subgroups based primarily on variation in the amount of mafic minerals (amphibole, muscovite, and biotite) and opaques. The first subgroup comprises three sherds from the Doerschuk site. The matrix of these potsherds includes fragments of either polygranular quartz rock, or igneous rock comprising quartz, microline, plagioclase, amphibole, muscovite, and biotite minerals. Fourteen potsherds predominantly from the Doerschuk and Haw River sites represent the second subgroup. The major aplastic components of this group are quartz, feldspar, biotite, amphibole, and opaque minerals with igneous and polygranular quartz rock fragments. The primary petrographic distinction of this subgroup is that the majority of the igneous rock fragments have little or no mafic minerals. Furthermore, the feldspar rock and mineral fragments are often heavily altered, suggesting derivation from a felsic plutonic source. Group III encompasses the remainder of the samples (n=29) and is characterized by quartz monocrystalline mineral grains, quartz polygranular rock fragments and, in about half the 29 specimens, grog (crushed pottery used to temper the clay) as well as argillaceous clay fragments, probably related to the manufacture of this pottery.

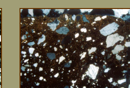
These data provide definitive evidence for the absence of calcareous material such as fossil or recent shell, carbonate rock such as limestone, mudstone, or caliche. The calcium/sodium-rich samples identified by the INAA correspond to mineral Groups I and II, which include calcium-rich minerals such as clinopyroxene (augite), plagioclase (labradorite) and amphibole. Potsherds identified by the INAA as having low calcium/sodium content correspond to the quartz-rich samples in Group III, which has more sodic plagioclase and potassium feldspar. Although petrographic data provided a more accurate interpretation of the composition of the 50 potsherds, the differentiation based on the amount of calcium and sodium identified in the INAA were little altered by the mineralogical data (Table 2). The geographic distribution of sites based on mineral groups replicates the basic pattern illustrated by the chemical data (Figure 4).

Group I (1 on map). (2.5X, cross-polarized.) Note the large pyroxene + plagioclase igneous rock fragment (~3 mm X 3 mm) added to clay as a tempering agent. Other aplastic components are pyroxene and plagioclase mineral grains derived from sedimentary reworking and weathering of Jurassic-age diabase. Green grains are pyroxene; intersecting lathe are plagioclase feldspar with Carlsbad twinning. The pyroxene is a clinopyroxene (probably augite) and the plagioclase is Ca-rich (probably laboradorite).

Group IIa (2 on map). (2.5X, cross-polarized.) Plagioclase + quartz + amphibole igneous rock fragment (right) showing sericite alteration. Mineral fragments of quartz, palgioclase (center bottom), and muscovite (blocky pastel grain right of center) and biotite (brown elongate and blocky grains) mica.



Group IIb (3 on map). (2.5X, cross-polarized.) Highly altered quartz-plagioclase igneous rock fragments. The alteration is both sericite (white mica) and epidote. These alteration minerals are associated with the plagioclase feldspar. Some of the rock fragments have mica (muscovite or biotite) and rarely amphibole. This group of sherds has less mafic minerals (such as amphibole) and more quartz and plagioclase (and some potassium feldspar) minerals.



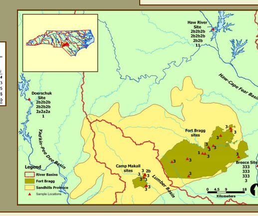
Group III (4 on map). (2.5X, cross-polarized.) Quartz ± feldspar and quartz polygranular rock fragments including some mica (generally muscovite), from 0–10 modal percent. Blocky to subangular feldspar (often microcline, but occasionally plagioclase and microcline) and subrounded to subangular quartz mineral and rock fragments. Tartan-plaid twinned microcline (k-spar: top, left of center) and some untwinned feldspar (blocky grain, right of center near top). Most angular to subangular grains are monocrystalline quartz, but a few are polygranular quartz grains (left of center, note mica lathe).

Table 2. Contingency Table of Mineralogical Groups and River Basin/Site Locations.

Mineral Groups	Pee Dee/ Doershuk	Haw/ Haw River	Cape Fear/ Breece	Lower Little/ Fort Bragg	Lumber/ Camp Mackall	Total
	River Basin/Site Location					
1	1	2		1		4
2a	3					3
2b	6	8			1	15
3			10	11	7	28
Total	10	10	10	12	8	50

Table 3. Contingency Table of Mineralogical and Chemical Groups.

Mineral Groups	1	2	5	3	4	unx	Total
	Chemical Groups						
1	3		1				4
2a	2		1				3
2b		5	4			6	15
3		3		15	6	4	28
Total	5	8	6	15	6	10	50



Figue 4. Sample locations and mineral groups (labeled for each sample from each site provenience). Notice the difference between Piedmont (Doerschuk and Haw River sites) and Coatal Plain sites.

CONCLUSIONS

The results of neutron activation and petrographic analyses distinguish two broad geographic source areas that correspond to the Piedmont and Coastal Plain provinces. Contingency Table 3 illustrates the association of mineral Groups I, IIa and IIb with chemical Groups 1, 2 and 5, representing mostly from Piedmont sites in the Pee Dee and Haw River basins. Mineral Group III is associated with chemical Groups 3 and 4, representing sites in the Coastal Plain in the Sandhills, Cape Fear and Lumber River basins. A few anomalous samples (circled in Table 3) do not fit the pattern. Mineralogical data indicate that almost all of the pottery in the 20-sherd Fort Bragg sample was derived from Coastal Plain resources. Chemical data provide a somewhat more complex picture suggesting the possibility that pottery was imported into the Sandhills from both Coastal Plain and Piedmont sources. The homogeneity of chemical signatures of the samples from the Doerschuk, Haw River and Breece sites suggests that potters at these locations were consistently relying upon the same, presumably locally available, resources. Greater variability in the samples from Fort Bragg suggests that either: (1) pots were being brought into the Sandhills, suggesting higher residential mobility than in surrounding regions, or (2) that the clay and temper sources in the Fort Bragg region are more chemically variable than the Pee Dee, Haw, and Cape Fear River counterparts.

The ability to discriminate between these two sources of variation (cultural or environmental) requires that we increase the sample size of pottery from each region and also expand the dataset by collecting raw clay samples for comparison. The analysis of additional potsherds and multiple clay samples from Fort Bragg will help to answer the question of chemical variability of resources in the Sandhills. Additional potsherds and raw clays from sources near the Doerschuk and Haw River sites will aid in refining chemical Groups 1, 2, and 5. Analysis of additional potsherds and clay samples from source areas near the Breece site will help to refine chemical Group 3, and will aid in resolving ambiguity regarding natural or cultural causes for the homogeneity of the sherds sampled in the first phase of research. In addition to increasing the sample size for chemical and mineralogical analyses, archaeologist will conduct a number of tests to determine the nature of the clay from a potter's perspective. Making and firing test tiles and replica vessels will provide information about the plasticity of the clay, its rate of shrinkage, and other factors affecting its performance, thus helping to answer the question of why particular resources were selected — ultimately, the question of interest.

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